

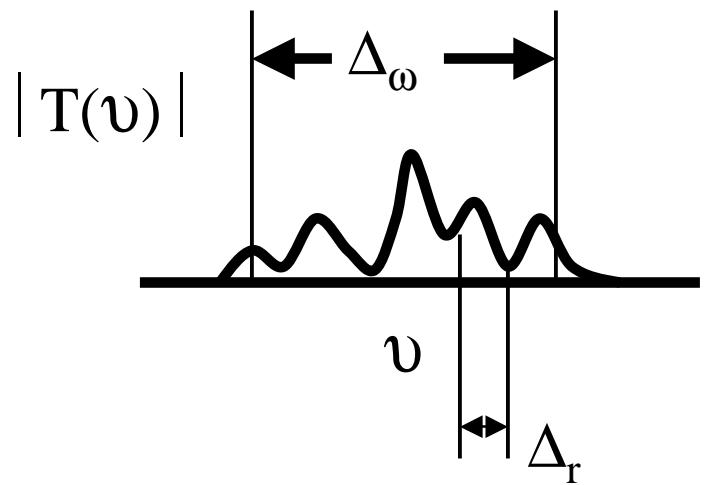
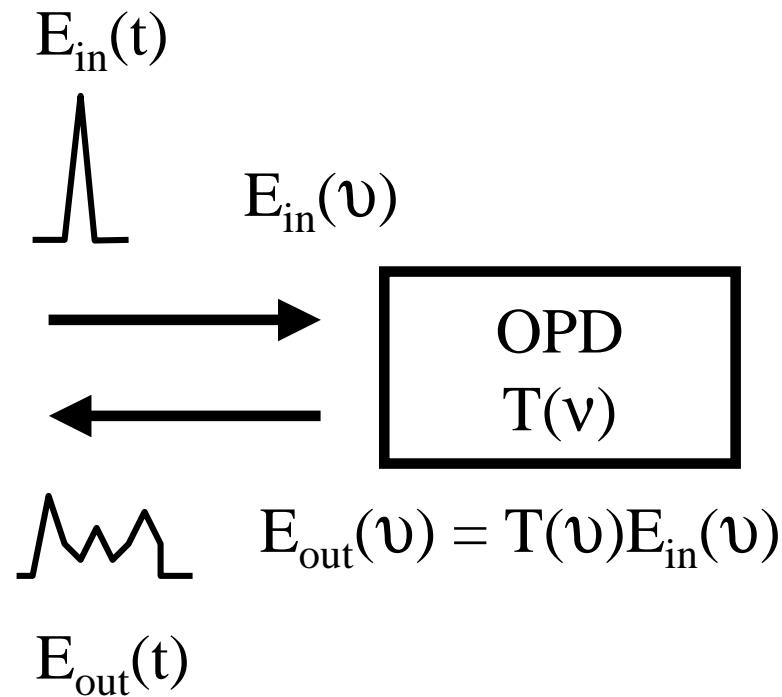


# High Performance Planar Holographic Optical Processors/Spectral Filters:

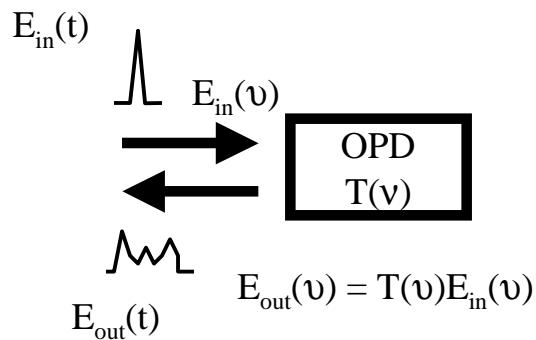
## Enablers of All-Optical Data Routing and Control

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# Optical Processor: Generic Function



# Optical Processor Applications: Pattern Recognition



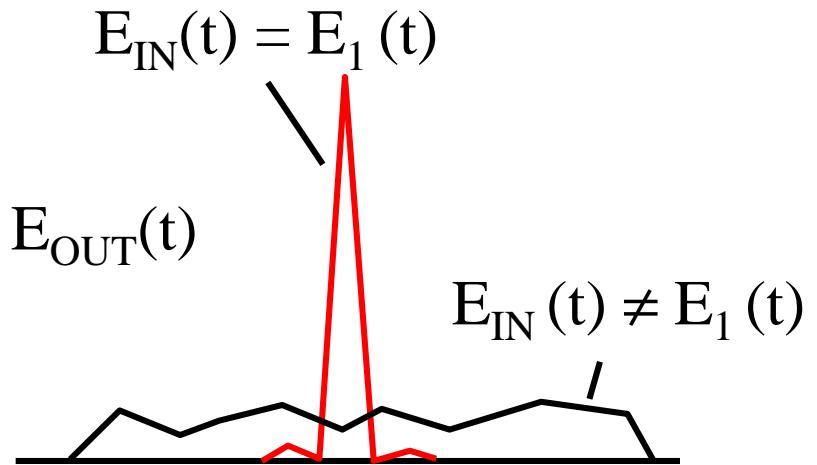
Program Spectral Filter  
to Recognize  $E_1(t)$

$$T(v) = E_1^*(v)$$

$$E_{OUT}(v) = E_1^*(v)E_{IN}(v)$$

$$= E_1(t) \text{ 7 } E_{IN}(t)$$

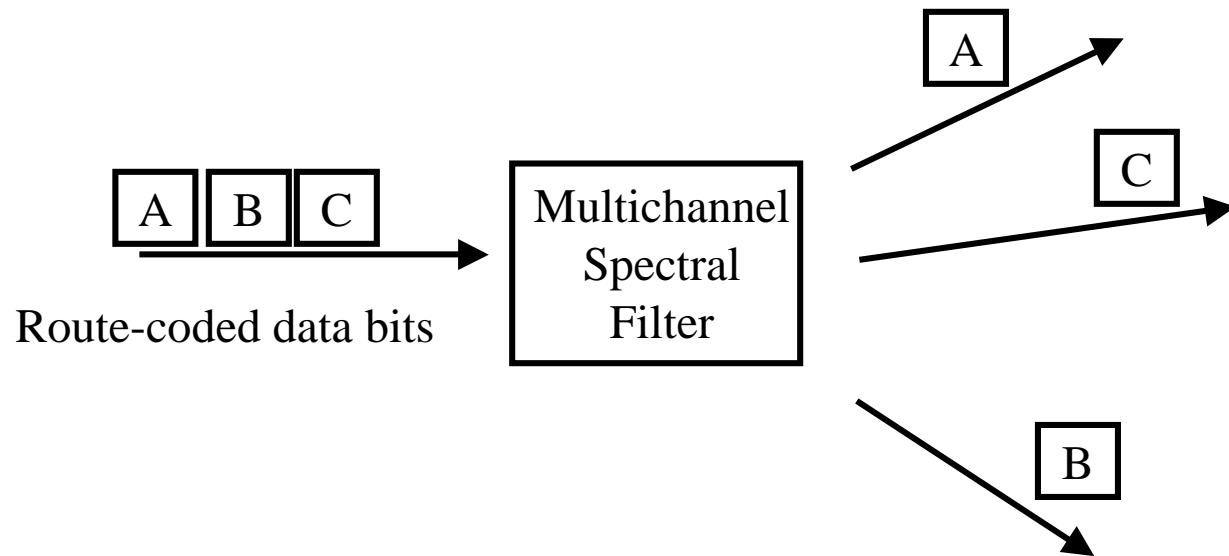
Cross-correlation



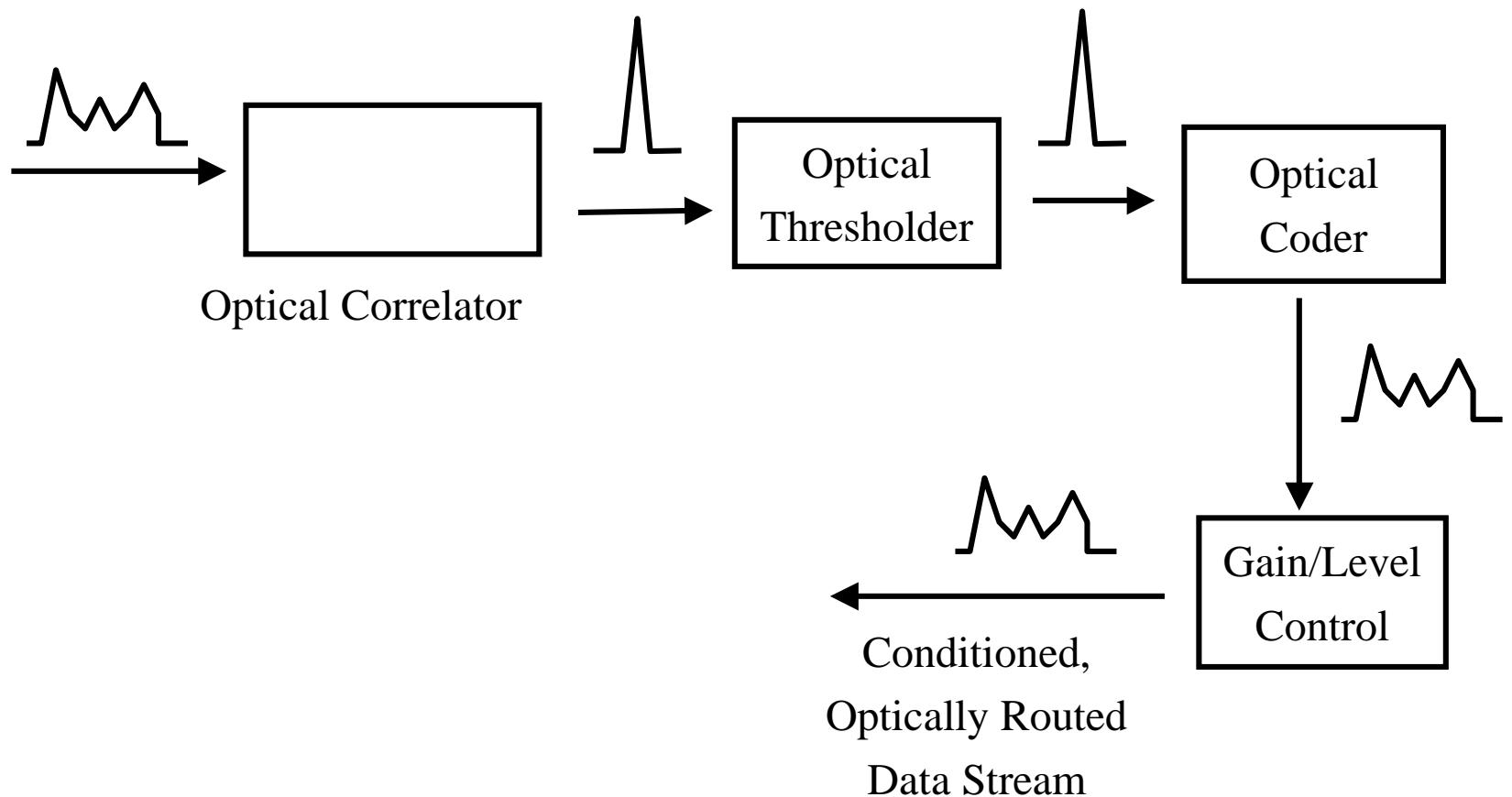
# Optical Intelligence/Signal Decoding

- Program optical processor to autocorrelate against specific temporal reference waveforms (data)
- Decode optical packets without electronic processing
- Route optical signals based on content

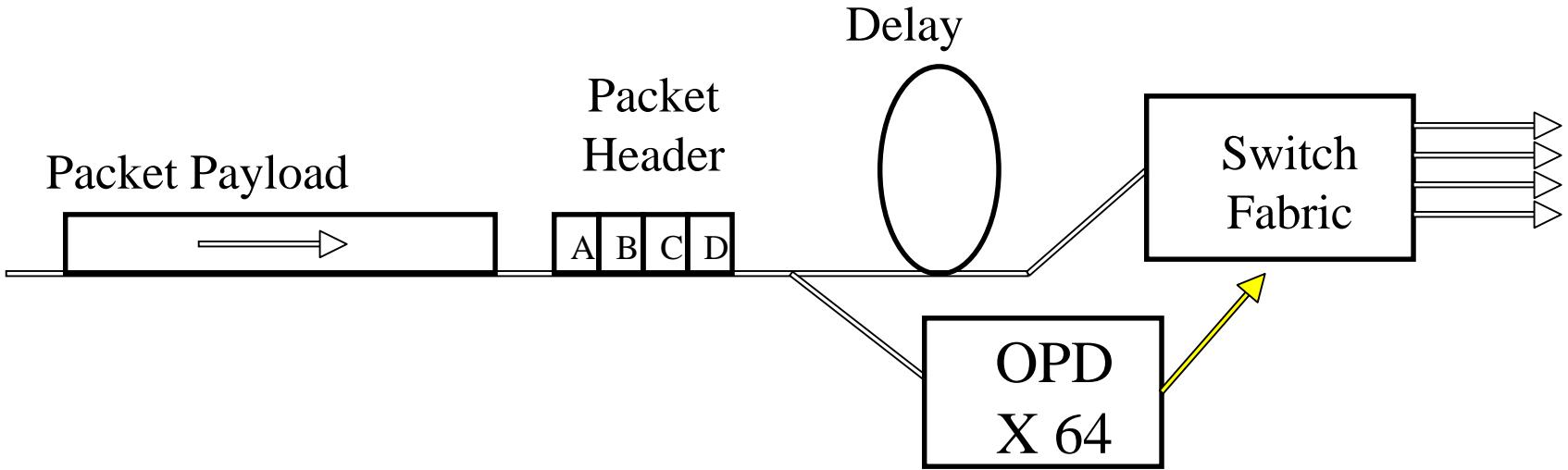
# Passive All-Optical Routing



# Routing and Regeneration



# Optically Assisted Routing



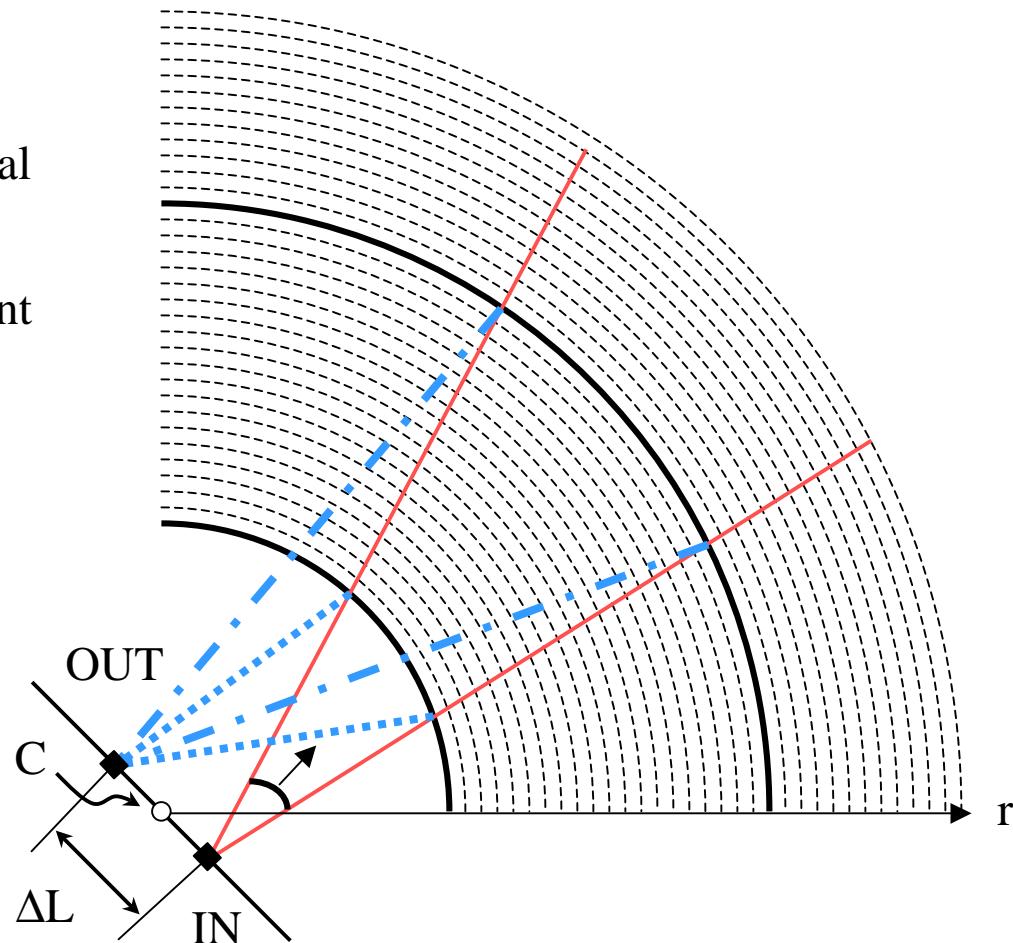
Decodes Header Subpackets as  
Single Units:  
Fast Optics – Slow Electronics

# Opportunity: Planar Holographic Bragg Reflectors

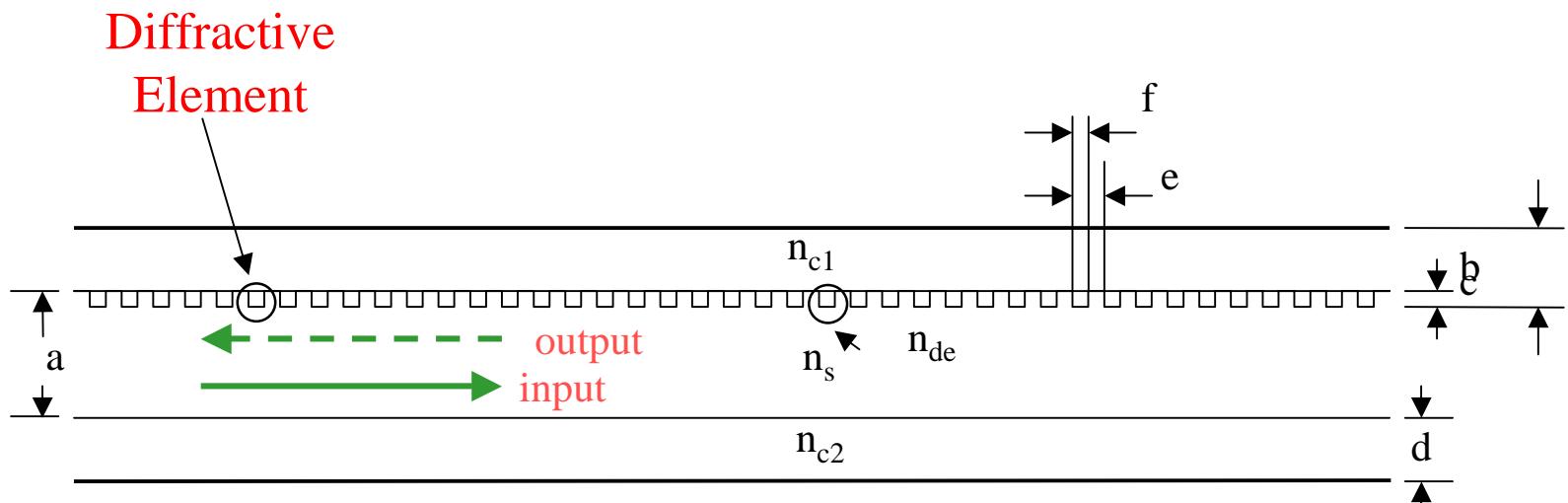
- High performance, arbitrary transfer function spectral filters
- Fully integrated devices
- Many spatially resolved spectral transfer functions per device
- Fabricated lithographically or by stamping/embossing

# A simple planar holographic Bragg reflector (top)

Arbitrary Spectral  
Filtering  
Spatial Wavefront  
Control



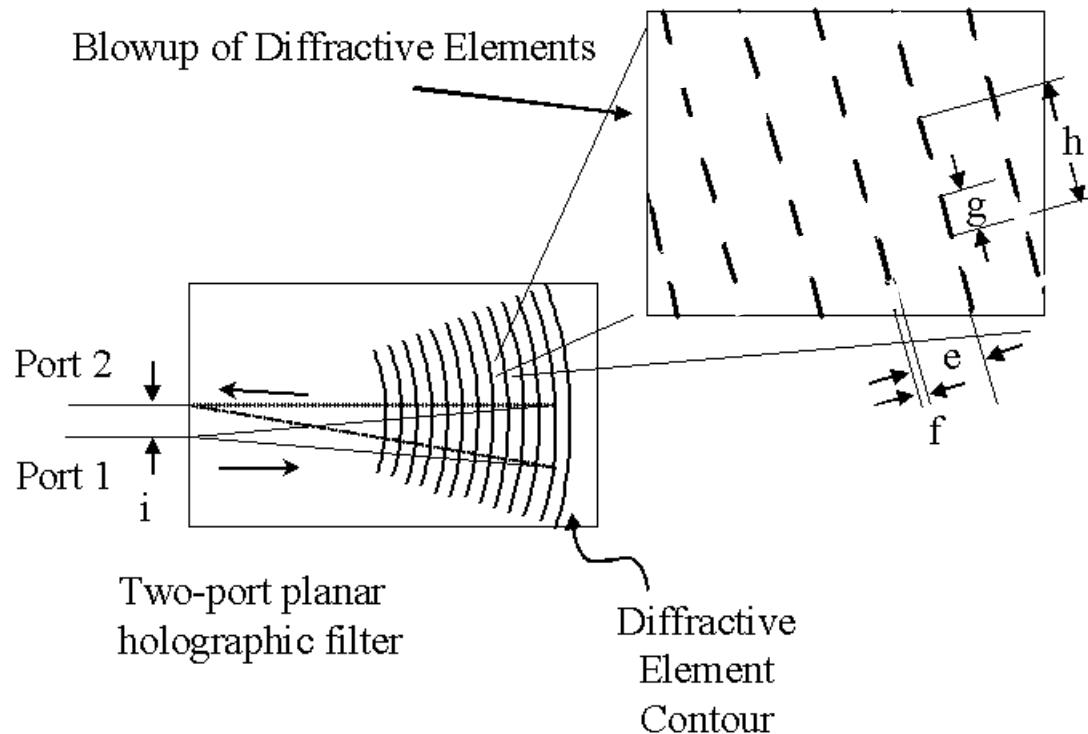
# A simple planar holographic Bragg reflector (cross section)



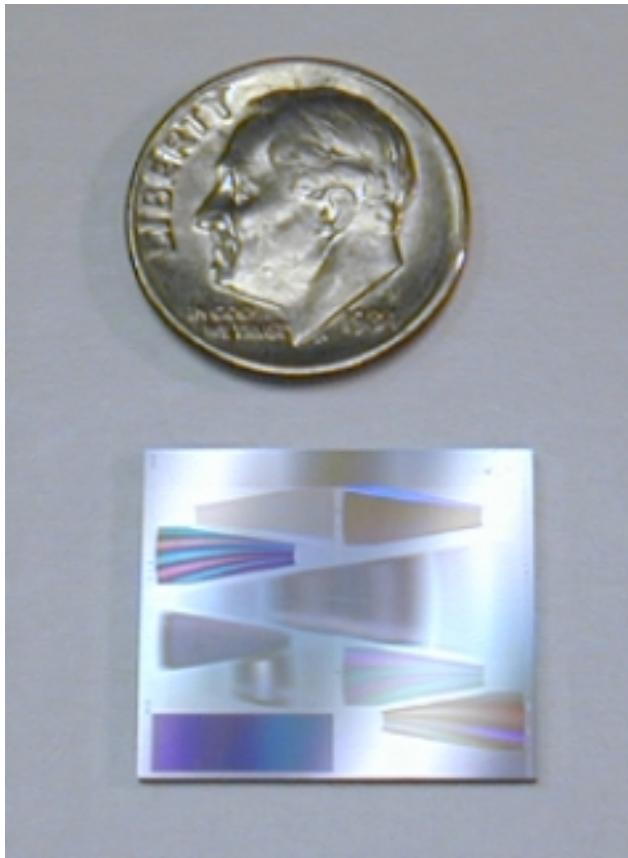
Spectral transfer function is proportional to the  
Spatial Fourier Transform of the Diffractive Elements

Amplitude (effective gray scale) and phase (spatial  
shift) on single diffractive element level available

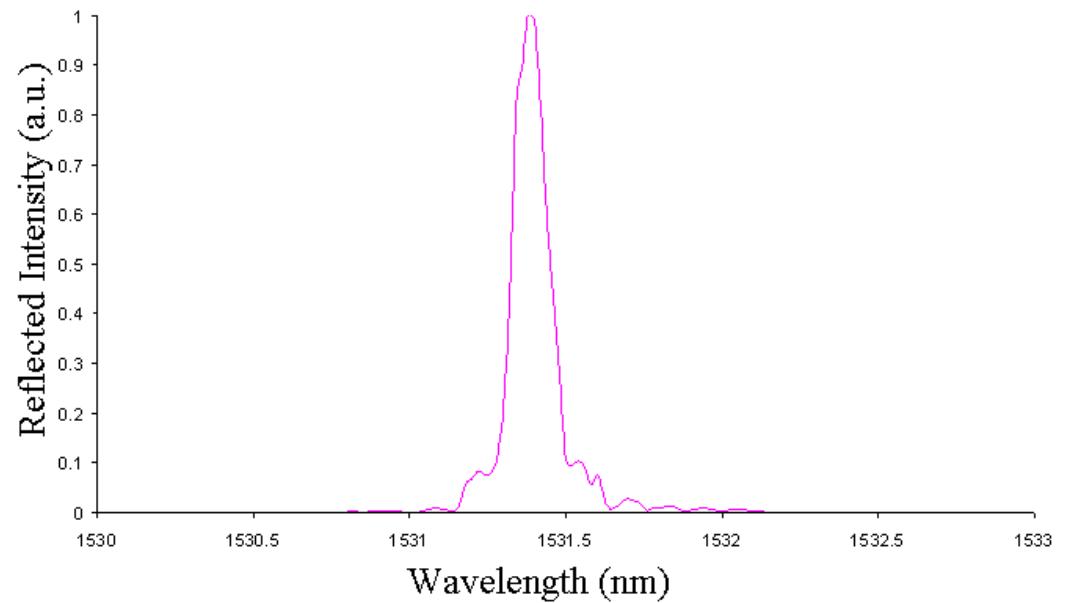
# Holographic Bragg Reflector with Effective Gray Scale



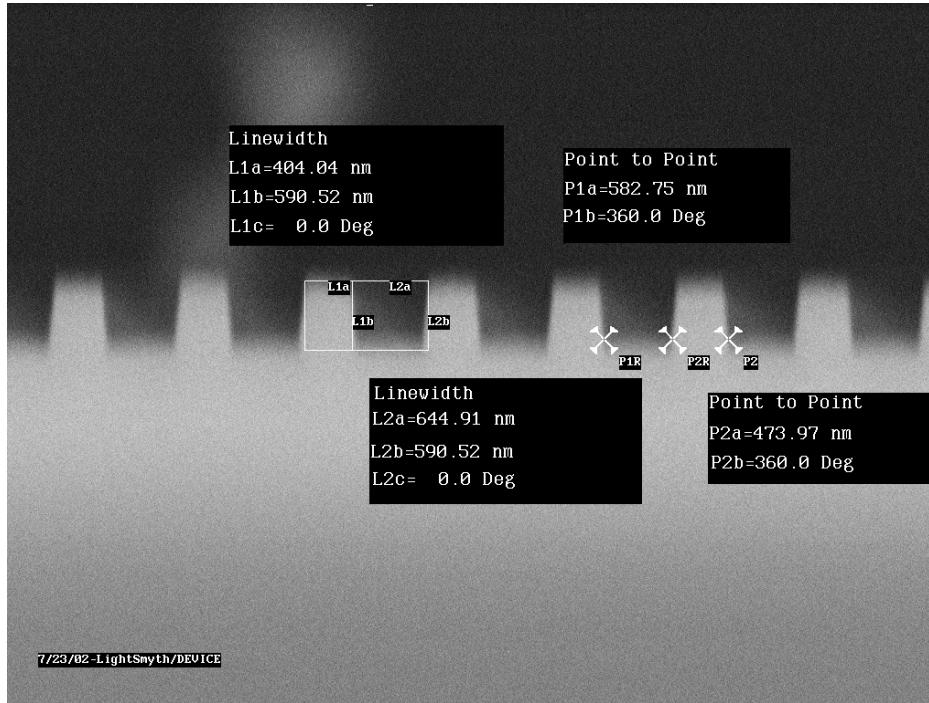
# Fabricated HBR's and Spectral Transfer Function



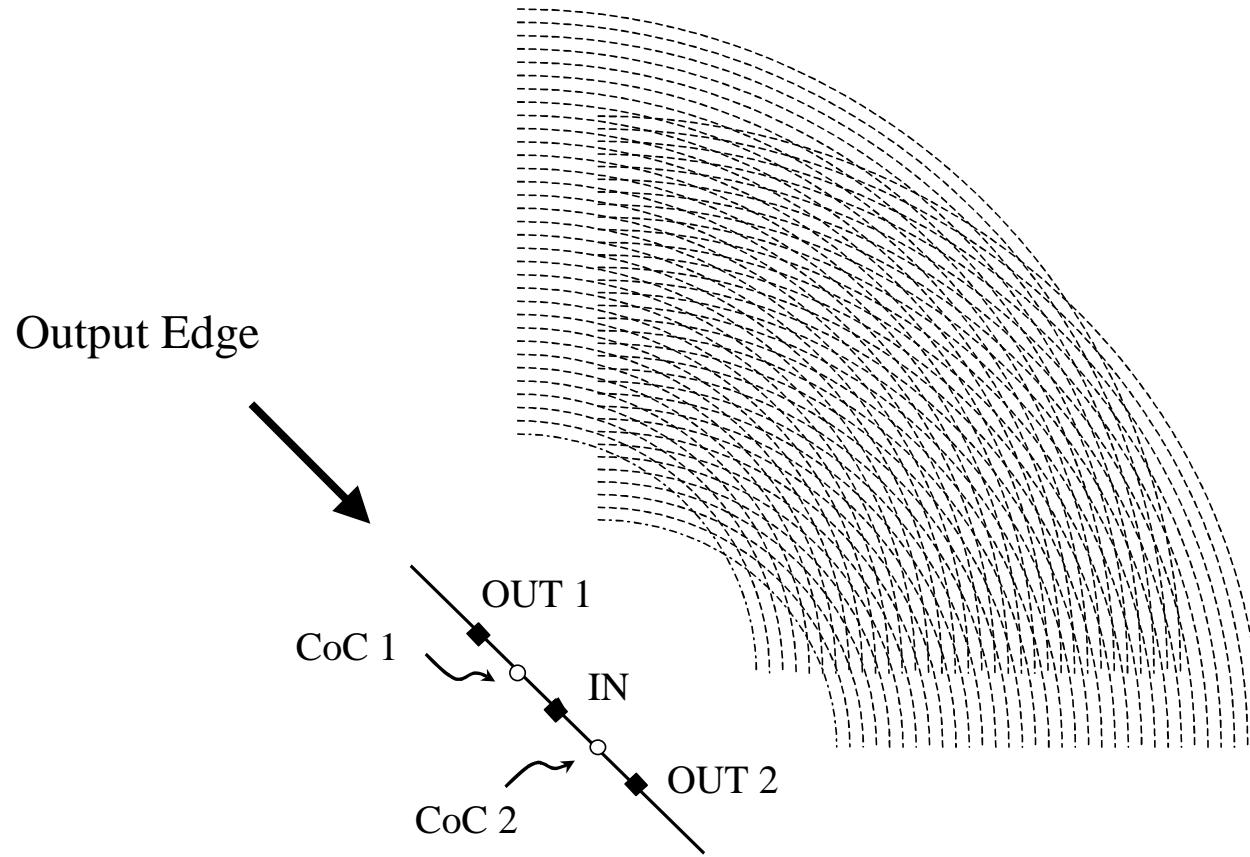
Silica-on-Silicon Format



7mm length gives  $10^4$  resolution (1.5 um)



# Overlain independent structures with partial scribing of diffractive elements (top view)



# Summary

- Powerful Optical Processing Platform
  - Fully integrated
  - Many channels per device
  - Low cost via embossing/stamping based fab
- Applications
  - Packetwise All-Optical Signal Decoding
  - All Optical Signal Routing
- Future Devices Promise Elements of Dynamic Reconfigurability (nice but not necessary).